

The Blue Ribbon Panel on Oxygenates in Gasoline

Executive Summary and Recommendations

Final, July 27, 1999

Introduction

The Federal Reformulated Gasoline Program (RFG) established in the Clean Air Act Amendments of 1990, and implemented in 1995, has provided substantial reductions in the emissions of a number of air pollutants from motor vehicles, most notably volatile organic compounds (precursors of ozone), carbon monoxide, and mobile-source air toxics (benzene, 1,3-butadiene, and others), in most cases resulting in emissions reductions that exceed those required by law. To address its unique air pollution challenges, California has adopted similar but more stringent requirements for California RFG.

The Clean Air Act requires that RFG contain 2% oxygen, by weight. Over 85% of RFG contains the oxygenate methyl tertiary butyl ether (MTBE) and approximately 8% contains ethanol - a domestic fuel-blending stock made from grain and potentially from recycled biomass waste. There is disagreement about the precise role of oxygenates in attaining the RFG air quality benefits although there is evidence from the existing program that increased use of oxygenates results in reduced carbon monoxide emissions, and it appears that additives contribute to reductions in aromatics in fuels and related air benefits. It is possible to formulate gasoline without oxygenates that can attain similar air toxics reductions, but less certain that, given current federal RFG requirements, all fuel blends created without oxygenates could maintain the benefits provided today by oxygenated RFG.

At the same time, the use of MTBE in the program has resulted in growing detections of MTBE in drinking water, with between 5% and 10% of drinking water supplies in high oxygenate use areas¹ showing at least detectable amounts of MTBE. The great majority of these detections to date have been well below levels of public health concern, with approximately one percent rising to levels above 20 ppb. Detections at lower levels have, however, raised consumer taste and odor concerns that have caused water suppliers to stop using some water supplies and to

¹ Areas using RFG (2% by weight oxygen) and/or Oxyfuel (2.7% by weight Oxygen)

incur costs of treatment and remediation. The contaminated wells include private wells that are less well protected than public drinking water supplies and not monitored for chemical contamination. There is also evidence of contamination of surface waters, particularly during summer boating seasons.

The major source of groundwater contamination appears to be releases from underground gasoline storage systems (UST). These systems have been upgraded over the last decade, likely resulting in reduced risk of leaks. However, approximately 20% of the storage systems have not yet been upgraded, and there continue to be reports of releases from some upgraded systems, due to inadequate design, installation, maintenance, and/or operation. In addition, many fuel storage systems (e.g. farms, small above-ground tanks) are not currently regulated by U.S. EPA. Beyond groundwater contamination from UST sources, the other major sources of water contamination appear to be small and large gasoline spills to ground and surface waters, and recreational water craft - particularly those with older motors - releasing unburned fuel to surface waters.

The Blue Ribbon Panel

In November, 1998, U.S. EPA Administrator Carol M. Browner appointed a Blue Ribbon Panel to investigate the air quality benefits and water quality concerns associated with oxygenates in gasoline, and to provide independent advice and recommendations on ways to maintain air quality while protecting water quality. The Panel, which met six times from January - June, 1999, heard presentations in Washington, the Northeast, and California about the benefits and concerns related to RFG and the oxygenates; gathered the best available information on the program and its effects; identified key data gaps; and evaluated a series of alternative recommendations based on their effects on:

- air quality
- water quality
- stability of fuel supply and cost

The Findings and Recommendations of the Blue Ribbon Panel

Findings Based on its review of the issues, the Panel made the following overall findings:

- The distribution, use, and combustion of gasoline poses risks to our environment and public health.
- RFG provides considerable air quality improvements and benefits for millions of US citizens.
- The use of MTBE has raised the issue of the effects of both MTBE alone and MTBE in gasoline. This panel was not constituted to perform an independent comprehensive health assessment and has chosen to rely on recent reports by a

number of state, national, and international health agencies. What seems clear, however, is that MTBE, due to its persistence and mobility in water, is more likely to contaminate ground and surface water than the other components of gasoline.

- MTBE has been found in a number of water supplies nationwide, primarily causing consumer odor and taste concerns that have led water suppliers to reduce use of those supplies. Incidents of MTBE in drinking water supplies at levels well above EPA and state guidelines and standards have occurred, but are rare. The Panel believes that the occurrence of MTBE in drinking water supplies can and should be substantially reduced.
- MTBE is currently an integral component of the U.S. gasoline supply both in terms of volume and octane. As such, changes in its use, with the attendant capital construction and infrastructure modifications, must be implemented with sufficient time, certainty, and flexibility to maintain the stability of both the complex U. S. fuel supply system and gasoline prices.

The following recommendations are intended to be implemented as *a single package* of actions designed to simultaneously maintain air quality benefits while enhancing water quality protection and assuring a stable fuel supply at reasonable cost. The majority of these recommendations could be implemented by federal and state environmental agencies without further legislative action, and we would urge their rapid implementation. We would, as well, urge all parties to work with Congress to implement those of our recommendations that require legislative action.

Recommendations to Enhance Water Protection

Based on its review of the existing federal, state and local programs to protect, treat, and remediate water supplies, the Blue Ribbon Panel makes the following recommendations to enhance, accelerate, and expand existing programs to improve protection of drinking water supplies from contamination.

Prevention

1. EPA, working with the states, should take the following actions to enhance significantly the Federal and State Underground Storage Tank programs:
 - a. Accelerate enforcement of the replacement of existing tank systems to conform with the federally-required December 22, 1998 deadline for upgrade, including, at a minimum, moving to have all states prohibit fuel deliveries to non-upgraded tanks, and adding enforcement and compliance resources to ensure prompt enforcement action, especially in areas using RFG and Wintertime Oxyfuel.

- b. Evaluate the field performance of current system design requirements and technology and, based on that evaluation, improve system requirements to minimize leaks/releases, particularly in vulnerable areas (see recommendations on Wellhead Protection Program in 2. below)
 - c. Strengthen release detection requirements to enhance early detection, particularly in vulnerable areas, and to ensure rapid repair and remediation
 - d. Require monitoring and reporting of MTBE and other ethers in groundwater at all UST release sites
 - e. Encourage states to require that the proximity to drinking water supplies, and the potential to impact those supplies, be considered in land-use planning and permitting decisions for siting of new UST facilities and petroleum pipelines.
 - f. Implement and/or expand programs to train and license UST system installers and maintenance personnel.
 - g. Work with Congress to examine and, if needed, expand the universe of regulated tanks to include underground and aboveground fuel storage systems that are not currently regulated yet pose substantial risk to drinking water supplies.
2. EPA should work with its state and local water supply partners to enhance implementation of the Federal and State Safe Drinking Water Act programs to:
- a. Accelerate, particularly in those areas where RFG or Oxygenated Fuel is used, the assessments of drinking water source protection areas required in Section 1453 of the 1996 Safe Drinking Water Act Amendments.
 - b. Coordinate the Source Water Assessment program in each state with federal and state Underground Storage Tank Programs using geographic information and other advanced data systems to determine the location of drinking water sources and to identify UST sites within source protection zones.
 - c. Accelerate currently-planned implementation of testing for and reporting of MTBE in public drinking water supplies to occur before 2001.
 - d. Increase ongoing federal, state, and local efforts in Wellhead Protection Areas including:
 - enhanced permitting, design, and system installation requirements for USTs and pipelines in these areas;
 - strengthened efforts to ensure that non-operating USTs are properly closed;
 - enhanced UST release prevention and detection
 - improved inventory management of fuels.
3. EPA should work with states and localities to enhance their efforts to protect lakes and reservoirs that serve as drinking water supplies by restricting use of

recreational water craft, particularly those with older motors.

4. EPA should work with other federal agencies, the states, and private sector partners to implement expanded programs to protect private well users, including, but not limited to:
 - a. A nationwide assessment of the incidence of contamination of private wells by components of gasoline as well as by other common contaminants in shallow groundwater;
 - b. Broad-based outreach and public education programs for owners and users of private wells on preventing, detecting, and treating contamination;
 - c. Programs to encourage and facilitate regular water quality testing of private wells.
5. Implement, through public-private partnerships, expanded Public Education programs at the federal, state, and local levels on the proper handling and disposal of gasoline.
6. Develop and implement an integrated field research program into the groundwater behavior of gasoline and oxygenates, including:
 - a. Identifying and initiating research at a population of UST release sites and nearby drinking water supplies including sites with MTBE, sites with ethanol, and sites using no oxygenate;
 - b. Conducting broader, comparative studies of levels of MTBE, ethanol, benzene, and other gasoline compounds in drinking water supplies in areas using primarily MTBE, areas using primarily ethanol, and areas using no or lower levels of oxygenate.

Treatment and Remediation

7. EPA should work with Congress to expand resources available for the up-front funding of the treatment of drinking water supplies contaminated with MTBE and other gasoline components to ensure that affected supplies can be rapidly treated and returned to service, or that an alternative water supply can be provided. This could take a number of forms, including but not limited to:
 - a. Enhancing the existing Federal Leaking Underground Storage Tank Trust Fund by fully appropriating the annual available amount in the Fund, ensuring that treatment of contaminated drinking water supplies can be funded, and streamlining the procedures for obtaining funding.
 - b. Establishing another form of funding mechanism which ties the funding more directly to the source of contamination.
 - c. Encouraging states to consider targeting State Revolving Funds (SRF) to help accelerate treatment and remediation in high priority areas.

8. Given the different behavior of MTBE in groundwater when compared to other components of gasoline, states in RFG and Oxyfuel areas should reexamine and enhance state and federal “triage” procedures for prioritizing remediation efforts at UST sites based on their proximity to drinking water supplies.
9. Accelerate laboratory and field research, and pilot projects, for the development and implementation of cost-effective water supply treatment and remediation technology, and harmonize these efforts with other public/private efforts underway.

Recommendations for Blending Fuel for Clean Air and Water

Based on its review of the current water protection programs, and the likely progress that can be made in tightening and strengthening those programs by implementing Recommendations 1 - 9 above, the Panel agreed broadly, although not unanimously, that even enhanced protection programs will not give adequate assurance that water supplies will be protected, and that changes need to be made to the RFG program to reduce the amount of MTBE being used, while ensuring that the air quality benefits of RFG, and fuel supply and price stability, are maintained.

Given the complexity of the national fuel system, the advantages and disadvantages of each of the fuel blending options the Panel considered (see Appendix A), and the need to maintain the air quality benefits of the current program, the Panel recommends an *integrated package* of actions by both Congress and EPA that should be *implemented as quickly as possible*. The key elements of that package, described in more detail below, are:

- Action agreed to broadly by the Panel to reduce the use of MTBE substantially (with some members supporting its complete phase out), and action by Congress to clarify federal and state authority to regulate and/or eliminate the use of gasoline additives that threaten drinking water supplies;
- Action by Congress to remove the current 2% oxygen requirement to ensure that adequate fuel supplies can be blended in a cost-effective manner while quickly reducing usage of MTBE; and
- Action by EPA to ensure that there is no loss of current air quality benefits.

The Oxygen Requirement

10. The current Clean Air Act requirement to require 2% oxygen, by weight, in RFG must be removed in order to provide flexibility to blend adequate fuel supplies in a cost-effective manner while quickly reducing usage of MTBE and maintaining air quality benefits.

The panel recognizes that Congress, when adopting the oxygen requirement, sought to advance several national policy goals (energy security and diversity, agricultural policy, etc) that are beyond the scope of our expertise and deliberations.

The panel further recognizes that if Congress acts on the recommendation to remove the requirement, Congress will likely seek other legislative mechanisms to fulfill these other national policy interests.

Maintaining Air Benefits

11. Present toxic emission performance of RFG can be attributed, to some degree, to a combination of three primary factors: 1) mass emission performance requirements, 2) the use of oxygenates, and 3) a necessary compliance margin with a per gallon standard. In Cal RFG, caps on specific components of fuel is an additional factor to which toxics emission reductions can be attributed.

Outside of California, lifting the oxygen requirement as recommended above may lead to fuel reformulations that achieve the minimum performance standards required under the 1990 Act, rather than the larger air quality benefits currently observed. In addition, changes in the RFG program could have adverse consequences for conventional gasoline as well.

Within California, lifting the oxygen requirement will result in greater flexibility to maintain and enhance emission reductions, particularly as California pursues new formulation requirements for gasoline.

In order to ensure that there is no loss of current air quality benefits, EPA should seek appropriate mechanisms for both the RFG Phase II and Conventional Gasoline programs to define and maintain in RFG II the real world performance observed in RFG Phase I while preventing deterioration of the current air quality performance of conventional gasoline.²

There are several possible mechanisms to accomplish this. One obvious way is to enhance the mass-based performance requirements currently used in the program. At the same time, the panel recognizes that the different exhaust components pose differential risks to public health due in large degree to their variable potency. The panel urges EPA to explore and implement mechanisms to achieve equivalent

²The Panel is aware of the current proposal for further changes to the sulfur levels of gasoline and recognizes that implementation of any change resulting from the Panel's recommendations will, of necessity, need to be coordinated with implementation of these other changes. However, a majority of the panel considered the maintenance of current RFG air quality benefits as separate from any additional benefits that might accrue from the sulfur changes currently under consideration.

or improved public health results that focus on reducing those compounds that pose the greatest risk.

Reducing the Use of MTBE

12. The Panel agreed broadly that, in order to minimize current and future threats to drinking water, the use of MTBE should be reduced substantially. Several members believed that the use of MTBE should be phased out completely. The Panel recommends that Congress act quickly to clarify federal and state authority to regulate and/or eliminate the use of gasoline additives that pose a threat to drinking water supplies³.

Initial efforts to reduce should begin immediately, with substantial reductions to begin as soon as Recommendation 10 above - the removal of the 2% oxygen requirement - is implemented⁴. Accomplishing any such major change in the gasoline supply without disruptions to fuel supply and price will require adequate lead time - up to 4 years if the use of MTBE is eliminated, sooner in the case of a substantial reduction (e.g. returning to historical levels of MTBE use).

The Panel recommends, as well, that any reduction should be designed so as to

³Under §211 of the 1990 Clean Air Act, Congress provided EPA with authority to regulate fuel formulation to improve air quality. In addition to EPA's national authority, in §211(c)(4) Congress sought to balance the desire for maximum uniformity in our nation's fuel supply with the obligation to empower states to adopt measures necessary to meet national air quality standards. Under §211(c)(4), states may adopt regulations on the components of fuel, but must demonstrate that 1) their proposed regulations are needed to address a violation of the NAAQS and 2) it is not possible to achieve the desired outcome without such changes.

The panel recommends that Federal law be amended to clarify EPA and state authority to regulate and/or eliminate gasoline additives that threaten water supplies. It is expected that this would be done initially on a national level to maintain uniformity in the fuel supply. For further action by the states, the granting of such authority should be based upon a similar two part test:

- 1) states must demonstrate that their water resources are at risk from MTBE use, above and beyond the risk posed by other gasoline components at levels of MTBE use present at the time of the request.
- 2) states have taken necessary measures to restrict/eliminate the presence of gasoline in the water resource. To maximize the uniformity with which any changes are implemented and minimize impacts on cost and fuel supply, the panel recommends that EPA establish criteria for state waiver requests including but not limited to:
 - a. Water quality metrics necessary to demonstrate the risk to water resources and air quality metrics to ensure no loss of benefits from the federal RFG program.
 - b. Compliance with federal requirements to prevent leaking and spilling of gasoline.
 - c. Programs for remediation and response.
 - d. A consistent schedule for state demonstrations, EPA review, and any resulting regulation of the volume of gasoline components in order to minimize disruption to the fuel supply system.

⁴Although a rapid, substantial reduction will require removal of the oxygen requirement, EPA should, in order to enable initial reductions to occur as soon as possible, review administrative flexibility under existing law to allow refiners who desire to make reductions to begin doing so.

not result in an increase in MTBE use in Conventional Gasoline areas.

13. The other ethers (e.g. ETBE, TAME, and DIPE) have been less widely used and less widely studied than MTBE. To the extent that they have been studied, they appear to have similar, but not identical, chemical and hydrogeologic characteristics. The Panel recommends accelerated study of the health effects and groundwater characteristics of these compounds before they are allowed to be placed in widespread use.

In addition, EPA and others should accelerate ongoing research efforts into the inhalation and ingestion health effects, air emission transformation byproducts, and environmental behavior of all oxygenates and other components likely to increase in the absence of MTBE. This should include research on ethanol, alkylates, and aromatics, as well as of gasoline compositions containing those components.

14. To ensure that any reduction is adequate to protect water supplies, the Panel recommends that EPA, in conjunction with USGS, the Departments of Agriculture and Energy, industry, and water suppliers, should move quickly to:
 - a. Conduct short-term modeling analyses and other research based on existing data to estimate current and likely future threats of contamination;
 - b. Establish routine systems to collect and publish, at least annually, all available monitoring data on:
 - use of MTBE, other ethers, and Ethanol,
 - levels of MTBE, Ethanol, and petroleum hydrocarbons found in ground, surface and drinking water,
 - trends in detections and levels of MTBE, Ethanol, and petroleum hydrocarbons in ground and drinking water;
 - c. Identify and begin to collect additional data necessary to adequately assist the current and potential future state of contamination.

The Wintertime Oxyfuel Program

The Wintertime Oxyfuel Program continues to provide a means for some areas of the country to come into, or maintain, compliance with the Carbon Monoxide standard. Only a few metropolitan areas continue to use MTBE in this program. In most areas today, ethanol can and is meeting these wintertime needs for oxygen without raising volatility concerns given the season.

15. The Panel recommends that the Wintertime Oxyfuel program be continued (a) for as long as it provides a useful compliance and/or maintenance tool for the affected states and metropolitan areas, and (b) assuming that the clarification of state and federal authority described above is enacted to enable states, where necessary, to

regulate and/or eliminate the use of gasoline additives that threaten drinking water supplies.

Recommendations for Evaluating and Learning From Experience

The introduction of reformulated gasoline has had substantial air quality benefits, but has at the same time raised significant issues about the questions that should be asked before widespread introduction of a new, broadly-used product. The unanticipated effects of RFG on groundwater highlight the importance of exploring the potential for adverse effects in all media (air, soil, and water), and on human and ecosystem health, before widespread introduction of any new, broadly-used, product.

16. In order to prevent future such incidents, and to evaluate of the effectiveness and the impacts of the RFG program, EPA should:
 - d. Conduct a full, multi-media assessment (of effects on air, soil, and water) of any major new additive to gasoline prior to its introduction.
 - e. Establish routine and statistically valid methods for assessing the actual composition of RFG and its air quality benefits, including the development, to the maximum extent possible, of field monitoring and emissions characterization techniques to assess “real world” effects of different blends on emissions
 - f. Establish a routine process, perhaps as a part of the Annual Air Quality trends reporting process, for reporting on the air quality results from the RFG program.
 - g. Build on existing public health surveillance systems to measure the broader impact (both beneficial and adverse) of changes in gasoline formulations on public health and the environment.

Appendix A

In reviewing the RFG program, the panel identified three main options (MTBE and other ethers, ethanol, and a combination of alkylates and aromatics) for blending to meet air quality requirements. They identified strength and weaknesses of each option:

MTBE/other ethers	A cost-effective fuel blending component that provides high octane, carbon monoxide and exhaust VOCs emissions benefits, and appears to contribute to reduction of the use of aromatics with related toxics and other air quality benefits; has high solubility and low biodegradability in groundwater, leading to increased detections in drinking water, particularly in high MTBE use areas. Other ethers, such as ETBE, appear to have similar, but not identical, behavior in water, suggesting that more needs to be learned before widespread use
Ethanol	An effective fuel-blending component, made from domestic grain and potentially from recycled biomass, that provides high octane, carbon monoxide emission benefits, and appears to contribute to reduction of the use of aromatics with related toxics and other air quality benefits; can be blended to maintain low fuel volatility; could raise possibility of increased ozone precursor emissions as a result of commingling in gas tanks if ethanol is not present in a majority of fuels; is produced currently primarily in Midwest, requiring enhancement of infrastructure to meet broader demand; because of high biodegradability, may retard biodegradation and increase movement of benzene and other hydrocarbons around leaking tanks.
Blends of Alkylates and Aromatics	Effective fuel blending components made from crude oil; alkylates provide lower octane than oxygenates; increased use of aromatics will likely result in higher air toxics emissions than current RFG; would require enhancement of infrastructure to meet increased demand; have groundwater characteristics similar, but not identical, to other components of gasoline (i.e. low solubility and intermediate biodegradability)

Appendix B

Members of the Blue Ribbon Panel

Dan Greenbaum, Health Effects Institute, Chair
Mark Buehler, Metropolitan Water District, So. California
Robert Campbell, CEO, Sun Oil
Patricia Ellis, Hydrogeologist, Delaware Department of Natural Resources and Environmental Conservation
Linda Greer, Natural Resources Defense Council
Jason Grumet, NESCAUM
Anne Happel, Lawrence Livermore Nat. Lab
Carol Henry, American Petroleum Institute
Michael Kenny, California Air Resources Board
Robert Sawyer, University of California, Berkeley
Todd Sneller, Nebraska Ethanol Board
Debbie Starnes, Lyondell Chemical
Ron White, American Lung Assoc.

Federal representatives (Non-Voting):

Robert Perciasepe, Air and Radiation, US EPA
Roger Conway, US Dept. of Agriculture
Cynthia Dougherty, Drinking Water, U.S. EPA
William Farland, Risk Assessment, US EPA
Barry McNutt, US DOE
Margo Oge, Mobile Sources, US EPA
Samuel Ng, Underground Tanks, US EPA
Mary White, ATSDR
John Zogorski, USGS